Compression of binary streams down to their information content

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ABSTRACT

Any binary string can be compressed into a code-string (from which it is effectively recoverable) whose length is the Kolmogorov complexity of the original string. Moreover such shortest codes are known to be algorithmically random. Is there an analogue of these facts for binary streams, i.e. infinite binary sequences? We devise a coding method which compresses any given stream X into an algorithmically random stream Y, such that for each n, the first n bits X_n of X are uniformly recoverable from the first $I(X_n)$ bits of Y, where I is any information content measure with a certain property. An application of our result to the initial segment complexity of streams is the following: if g is a computable non-decreasing upper bound on the prefix-free complexity of X, then there exists an algorithmically random Y which computes X with oracle-use g.

Increasing dimension s to dimension t with few changes

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ABSTRACT

We show that for every $s < t \in [0, 1]$, every sequence of effective dimension s can be changed on density at most $H^{-1}(t) - H^{-1}(s)$ of its bits in order to obtain a sequence of effective dimension t, where H is the Shannon binary entropy function. The density bound is the best possible, and this answers a question which was left open at the time of previous presentations on this subject. Both this and previous results are found in [**?**].

References

[1] Greenberg, Miller, Shen & Westrick. *Dimension one sequences are close to randoms*, submitted.

Algorithmic Randomness and Amenable Groups

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ABSTRACT

The main space studied in algorithmic randomness is the space of all infinite binary strings. It is possible to transfer the study of algorithmic randomness to the set of functions from G to 0,1 where G is a countable group. In the case that G is amenable, different notions of complexity such as entropy and effective dimension can be translated to the new space as well. We will consider resent results of Simpson and Moriakov in this setting as well as some new theorems.

Rank and randomness

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ABSTRACT

We show that for each computable ordinal $\alpha > 0$ it is possible to find in each random Δ^0_2 degree a sequence R of Cantor-Bendixson rank α, while ensuring that the sequences that inductively witness R's rank are all Martin-Löf random with respect to a single countably supported and computable measure. This is a strengthening for random degrees of a recent result of Downey, Wu, and Yang, and can be understood as a randomized version of it.

Joint work with Christopher P. Porter

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Randomness and ITTMs

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ABSTRACT

We will present Infinite-Time Turing machines and study various related randomness notions. First, we will study the notions analogous to these in classical randomness, but using the power of ITTMs (such as Martin-Löf randomness). Second, we will study notions which appear to be specific to ITTMs, in particular the notion of ITTM-randomness, which present similarities with Π^1_1-randomness. We will also discuss the computational power of ITTMs. We will see that this power is sufficiently high to reach new interesting phenomenons and concepts which do not exist when considering lower computational models (such as higher computability). We will see how the interplay between these new phenomenons and ITTM-randomness brings new interesting questions and challenges, in the realm of higher computations.

Closure of resource bounded randomness notions under polynomial time permutations

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ABSTRACT

It is well known that computable randomness is closed under computable permutations. We investigate analogous statements for resource bounded randomness notions. Suppose S is a polynomial time computable permutation of the set of strings over the unary alphabet (identified with $\mathbb{N}$). If its inverse is not polynomially bounded, it is easy to build a polynomial time random bit sequence Z such that $Z \circ S$ is not polynomial time random. So one should only consider permutations S satisfying the extra condition that the inverse is polynomially bounded. Now the closure depends on additional assumptions in complexity theory. On the one hand, if $\mathsf{BPP} = \mathsf{EXP}$ then polynomial time randomness is not preserved by some permutation S such that in fact both S and its inverse are in P. On the other hand, we show that polynomial space randomness is preserved by polynomial time permutations with polynomially bounded inverse; so if $\mathsf{P} = \mathsf{PSPACE}$, then polynomial time randomness is preserved.

Analysis aspect of Ω operators

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ABSTRACT

We prove that Ω operator is an almost every where differentiable, comeagerly nondifferentiable, and nowhere monotone continuous function. We also investigate other analysis properties of Ω operators. This is joint work with Heidelberg logic team and its related people.